What is claimed is:

1. In a method for performing charged-particle-beam (CPB) microlithography of a specimen, a method for detecting a position of an alignment mark on the specimen, comprising:

(a) irradiating a charged particle beam onto an area of the specimen lacking an alignment mark, and detecting backscattered charged particles propagating from the irradiated area, so as to obtain a first backscattered-particle signal;

(b) irradiating the charged particle beam onto the alignment mark, and detecting backscattered charged particles propagating from the irradiated alignment mark, so as to obtain a second backscattered-particle signal;

(c) subtracting the first backscattered-particle signal from the second backscattered-particle signal to obtain a difference signal; and

(d) determining the alignment-mark position from the difference signal.

2. The method of claim 1, wherein step (a) is performed by scanning the charged particle beam across a smooth planar region of a surface of the specimen.

3. The method of claim 1, further comprising the steps of:

storing data in the first backscattered-particle signal in a memory; and

recalling the stored data from the memory and subtracting the recalled data from the second backscattered-particle signal to obtain the difference signal.

4. The method of claim 1, wherein:

the specimen has a crystal-orientation plane;

the first backscattered-particle signal is obtained by scanning the charged particle beam across a smooth planar region of a surface of the specimen representing a crystal-orientation plane of the specimen; and

in step (c), the subtraction of the first backscattered-particle signal from the second backscattered-particle signal removes data, concerning the crystal-orientation

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of the substrate, from the difference signal that otherwise would obfuscate data in the difference signal pertaining to the alignment mark.

5. The method of claim 4, wherein:

the first backscattered-particle signal is further obtained by changing an angle of incidence of the charged particle beam as the beam is scanned across the smooth planar region of the surface; and

a waveform of the first backscattered-particle signal exhibits a change in amplitude with corresponding changes in the angle of incidence.

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6. In a charged-particle-beam (CPB) microlithography apparatus including a CPB source that produces a charged particle beam, a CPB-optical system through which the charged particle beam passes from the CPB source to a substrate, and a substrate stage on which the substrate is placed for exposure by the charged particle beam, a device for measuring an alignment of the substrate, the device comprising:

a deflector situated and configured to deflect the charged particle beam to cause the beam to irradiate a predetermined location on the substrate mounted on the substrate stage, so as to cause the location to produce backscattered particles;

a backscattered-particle detector situated and configured to detect backscattered charged particles produced by the location on the substrate as the location is irradiated by the charged particle beam;

a controller connected to the deflector and the backscattered-particle detector, the controller being configured to (i) energize the deflector in a manner causing the deflector to irradiate the beam on a first location on the substrate lacking an alignment mark, thereby producing a background backscattered-particle signal; (ii) energize the deflector in a manner causing the deflector to irradiate the beam on a second location on the substrate in which an alignment mark is formed, thereby producing an alignment-mark backscattered-particle signal; (iii) calculate a difference signal by subtracting the background signal from the alignment-mark

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signal; and (iv) determine the position of the alignment mark from the difference signal.

7. A CPB microlithography apparatus, comprising a device for measuring substrate alignment as recited in claim 6.

8. A method for performing charged-particle-beam (CPB) microlithography of a specimen, comprising:

mounting the specimen on a substrate stage;

detecting a position of an alignment mark on the specimen using a method as recited in claim 1; and

microlithographically exposing a pattern onto the substrate.

9. A microelectronic-device fabrication process, comprising the steps:

(a) preparing a wafer specimen;

(b) processing the wafer specimen;

(c) assembling devices formed on the wafer specimen during steps (a) and (b), wherein step (b) comprises a method for performing CPB microlithography as recited in claim 8.

10. A microelectronic-device fabrication process, comprising the steps:

(a) preparing a wafer substrate;

(b) processing the wafer substrate;

(c) assembling devices formed on the wafer substrate during steps (a) and (b), wherein step (b) comprises the steps of (i) applying a resist to the wafer substrate; (ii) microlithographically exposing the resist; and (iii) developing the resist; and step (ii) comprises providing a CPB microlithography apparatus as recited in claim 7; and using the CPB microlithography apparatus to expose the resist with a pattern.

11. A microelectronic device, produced using a method as recited in claim 10.

12. A microelectronic device, produced using a method as recited in claim 9.

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